

POMEGRANATE A BOON TO DRY-LAND FARMERS

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ABSTRACT

India is one of the leading countries in pomegranate production. Over the last one decade the country has registered 15.7 and 16.1 percent increase in area and production, respectively. Pomegranate is a high value crop as its entire tree is of great economic importance. Besides, its demand for fresh fruit, several processed products like wine, juice concentrate, RTS beverages, anardana are also gaining importance in world trade. In recent years, pomegranate has gained importance for its versatile usage in processing, nutraceutical, pharmaceutical, leather and dying industries. Increased demand in the international market for pomegranate has widened the opportunity for high returns on investment from this crop. It is a highly remunerative crop and can elevate subsistence farming of small and marginal farmers to sustainable farming since it is well suited to the topography and agro-climate of arid and semi arid regions. The crop also has high potential to utilize wastelands.

KEYWORDS: Pomegranate & Arid Region

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DRY-LAND INTRODUCTION

Cultivation of horticultural crops by taking the advantage of the monsoon and adapting dry land technology principles for harvesting rainwater and conservation of moisture in order to get better yields and income is called dry land horticulture. Andhra Pradesh, Maharashtra, Tamil Nadu, Karnataka and Rajasthan have low and erratic rainfall coupled with extreme temperatures.

An agro-ecosystem is a complex entity comprising a number of elements which interact with one another to form and stabilize the system. An arid ecosystem differs in many respects from one of tropical or temperate zones. Unlike temperate zones, an arid zone is characterized as an area of low precipitation, high temperature, and high rate of evaporation. Frequency of rainfall does not describe accurately the type of the arid zone, nor does the amount of precipitation govern the type of vegetation. Nevertheless, precipitation serves as a criterion for the subdividing of arid zones. In the broad sense, 57-300 mm mean annual rainfall is typical of an arid zone, while 300-550 mm is that of a semi-arid zone (Thorntwaite, 1948). The dry climate of the world occurs in five great geographical areas lying between 15° and 35° latitude. The largest of the five, known as the African- Eurasian Dry Zone, includes the Sahara desert from the Atlantic coast, extending eastward to the Arabian Peninsula, Pakistan and India; northward, it includes Iran and southern Russia, and still farther north, it includes Chinese Turkestan

and Mongolia. The southern margin includes the semi-arid zone, the so-called 'Sahel' (Meigs, 1953).

REGION CHARACTERISTICS AND GEOGRAPHICAL SPREAD

The **Arid zone** has a high temperature, low humidity, low rainfall and erratic and poor textured soils. Rajasthan, Gujarat, some parts of Punjab, Haryana, Karnataka and Maharashtra. Crops grown under this area is pomegranate, Date palm, ber, custard apple and tamarind.

The **Semi-arid zone** exhibits low and erratic rainfall, low humidity and high temperature. Crops cultivated under this zone is mango, sapota, guava, jack, avocado, ber, tamarind and pomegranate

Agro-Climatic Zones of India and Andhra Pradesh

Table 1: Geographical Area of India is Divided into 15 Agro-Climatic Regions

	Area	Temperature	Rainfall	Soils	Horticultural Crops
1.Western Himalayan Region:	Jammu and Kashmir, Himachal Pradesh and the hill region of Uttarakhand.	July -5°C and 30 °C-January 5 °C and -5 °C	75 cm to 150 cm (Ladakh-less than 30 cm)	Alluvial soil in the valleys of Kashmir, Kullu and Dun, and brown soil in the hills	Apple apricot, pears, cherry, almond, litchis, walnut, etc. Saffron is grown in this region.
2.Eastern Himalayan Region:	Arunachal Pradesh, the hills of Assam, Sikkim, Meghalaya, Nagaland, Manipur, Mizoram, Tripura, and the Darjeeling district of West Bengal	July 25 °C and 30 °C January 10 °C and 20 °C	200-400 cm	Red-brown soil is not highly productive Jhuming (shifting cultivation) prevails in the hilly areas.	Potato, tea, pineapple, litchi, oranges and lime
3.Lower Gangetic Plain Region:	West Bengal (except the hilly areas), eastern Bihar and the Brahmaputra valley	July 26 °C to 41 °C and January from 9 °C to 24 °C	100 cm-200 cm	Alluvial	Potato, banana, mango and citrus fruits
4.Middle Gangetic Plain Region:	large parts of Uttar Pradesh and Bihar	July 26 °C to 41 °C and January 9 °C to 24 °C	100 cm and 200 cm	Fertile alluvial	Mustard and potato in rabi are important crops
5.Upper Gangetic Plains Region:	central and western parts of Uttar Pradesh and the Hardwar and Udham Nagar districts of Uttarakhand	July 26 °C to 41 °C and January 7 °C to 23 °C	75 cm-150 cm	Sandy loam	Mango, guava, phalsa and pomegranate
6.Trans-Ganga Plains Region:	Punjab, Haryana, Chandigarh, Delhi and the Ganganagar district of Rajasthan	July 25 °C and 40 °C and January 10 °C and 20 °C	65 cm and 125 cm	Alluvial	Pineapple, sapota and pomegranate
7.Eastern Plateau and Hills:	Chhotanagpur Plateau, extending over Jharkhand, Orissa,	July 26 °C to 34 °C and January 10 °C to	80 cm-150 cm of annual rainfall	Red and yellow with occasional patches of	Potato

	Chhattisgarh and Dandakaranya	27 °C		laterites and alluviums	
Table 1: Contd.,					
8. Central Plateau and Hills:	Bundelkhand, Baghelkhand, Bhandar Plateau, Malwa Plateau, and Vindhyaachal Hills	July 26 °C to 40 °C, and January 7 °C to 24 °C	50 cm-100 cm	Soils are mixed red, yellow and black.	Melons, pomegranate, guava, ber, citrus, tomato, onion, brinjal, cabbage and cauliflower
9. Western Plateau and Hills:	southern part of Malwa plateau and Deccan plateau (Maharashtra)	July temperature 24 °C and 41 °C and January 6 °C and 23 °C	25 cm-75 cm	Black soil	Ber, pomegranate, mango and guava
10. Southern Plateau and Hills:	interior Deccan and includes parts of southern Maharashtra, the greater parts of Karnataka, Andhra Pradesh, and Tamil Nadu uplands from Adilabad District in the north to Madurai District in the south	July 25 °C and 40 °C, and January 10 °C and 20 °C.	50 cm and 100 cm	Red and Black soils	Coffee, tea, cardamom and spices are grown along the hilly slopes of Karnataka plateau
11. Eastern Coastal Plains and Hills:	Coromandal and northern Circar coasts of Andhra Pradesh and Orissa	July 25 °C and 35 °C and January 20 °C and 30 °C	75 cm and 150 cm	Alluvial, loam and clay and are troubled by the problem of alkalinity	Pepper and cardamom
12. Western Coastal Plains and Ghats:	Malabar and Konkan coastal plains and the Sahyadris	July 25 °C and 30 °C And January 18 °C and 30 °C	more than 200 cm.	Laterite and coastal alluvial	Plantation crops and spices which are raised along the hill slopes of the Western Ghats.
13. Gujarat Plains and Hills:	hills and plains of Kathiawar, and the fertile valleys of Mahi and Sabarmati rivers	July 30 °C and January 25 °C	50 cm and 100 cm	Soils are regur in the plateau region, alluvium in the coastal plains, and red and yellow soils in Jamnagar area	Pomegranate, Phalsa, Ber and Custard apple
14. Western Dry Region:	Rajasthan, West of the Aravallis	June 28 °C to 45 °C and January 5 °C to 22 °C	less than 25 cm	Hot sandy desert	Water melon, guava and date palm, phalsa, fig, guava
15. Island Region:	Andaman-Nicobar and Lakshadweep	July 30 °C and January 25 °C (Port Blair being)	less than 300 cm	Soils vary from sandy along the coast to clayey loam in valleys and lower slopes	Areca nut, turmeric and cassava

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Agro Climatic Zones of Andhra Pradesh

Based on the agro climatic conditions, Andhra Pradesh is divided into seven zones. They are **1. Krishna – Godavari Zone:** Rainfall of this zone is 800-1100mm. Soil type is deltaic alluvium, red soils with clay, red loams, coastal sands and saline soils. Paddy, Groundnut, Jowar, Bajra, Tobacco, cotton, chilies, Sugar Cane and Horticultural Crops are the important crops grown. **2. North Coastal Zones:** This zone receives a rainfall of 1000-1100 mm mainly from the south west monsoon. Soil type is red soils with clay base, pockets of acidic soils, laterite soils, Soils with PH 4-5. The main crops grown in these zones are Paddy, Groundnut, Jowar, Bajra, Mesta, Jute, Sun hemp, Sesame, Black gram and Horticultural Crops. **3. Southern Zone:** Rainfall received is about 700-1100 mm. Soil type is Red loamy soils, Shallow to moderately deep. Crops like Paddy, Groundnut, cotton Sugarcane. Millets and Horticultural Crops are mainly grown. **4. North Telangana Zone:** Rainfall received is about 900-1500 mm. Soil type is Chalkas, Red sandy soils, Dubbas, Deep Red loamy soils, Very deep black cotton soils. Tuemic and Chillies are the important spice crops in Andhra Pradesh. **5. Southern Telangana Zone:** This zone receives a rainfall of about 700-900 mm. Soil type is red earth with loamy sub soil (Chalkas). Paddy, Sunflower, Safflower, Grapevine, Sorghum, Millets, Pulses and Orchard crops are the important crops. **6. Scarce rainfall zone:** Receives a rainfall of 500-750 mm. Soil type is red earths with loamy soils (Chalkas), red sandy soils and black cotton soils in pockets. Cotton, Korra, Sorghum, Millets, Groundnut, Pulses, Paddy is the important crops. **7. High altitude and Tribal areas:** This zone receives a rainfall more than 1400 mm. Horticultural Crops, Millets, Pulses Chillies, Turmeric and Pepper are the important crops grown.

SELECTION OF CROPS FOR DRY LAND

Important arid and semi arid crops for different arid climate or dry climate are Pomegranate, Ber, Aonla, Custard apple, Karonda, Tamrind, Jamun, Losoda, Fig, Date Palm, Passion fruit, Mangosteen, Lakooch, Kheer, Bael, mulberry, Wood apple, Pilu, Carombola rose apple, West Indian Cherry, Guava, Mango and Sapota

The Agro climate of an arid ecosystem makes fruit culture a difficult enterprise, but even under such environment pomegranate found to be a successful fruit crop. It has the capacity to withstand heat, drought and salinity, besides high profitability has made its cultivation increasingly attractive. It is currently ranked 18th in terms of annual global fruit consumption (Brodie 2009), with increasing demand, especially in developed countries due to its reported health benefits (opara *et al.*).

INTRODUCTION OF POMEGRANATE

Pomegranate (*Punica granatum* L.) is one of the famous table fruit, mainly cultivated in tropical and subtropical region, belongs to family puniceae. It is the symbol of health, fertility and the rebirth as mentioned many ancient cultures (Still 2006). It is considered to be one of the first five domesticated edible fruit crops, along with a Fig, Date palm, Grape and Olive. The scientific name *Punica granatum*, is derived from the name Pomum (Apple) granatus (grainy) or seeded apple. The Pomegranate is also called as Seeded apple, because of its nutritional benefits. Consumers preferred fruit juice, sweet-acidic and refreshing arils and there is a growing demand for good quality fruits both for fresh use and processing into juice, syrup and wine. The kernels are also used as garnish and salads. It has high therapeutic values for its usefulness in sickness, indigestion and leprosy cure. Gil *et al.*, (2000) reported that pomegranate based products have a property of anticancer activity, anti-tumor, cell proliferation and chronic inflammatory disease. The fruit is commercially cultivated in countries like Morocco, Pakistan (Baluchistan), Iraq, Iran, China, Japan, Russia and India. In India, it attained the

commercial status only after 1985-86 and now, it is being cultivated on scientific lines, particularly in the states of Maharashtra, Karnataka, Gujarat, Andra Pradesh, Tamil Nadu and Rajasthan.

In India, pomegranate cultivated in an area of about 113.00 thousand ha and production is around 745.00 thousand tons. In India, Maharashtra is the leading producer of pomegranates with an area of 78.00 thousand ha and 408.00 thousand ha production. Research initiatives in India have lead to the development of some outstanding cultivars like G-137, Bhagwa and Mridula, which has revolutionized pomegranate industry in the country. Major Producing belts in Andhra Pradesh are Nellore, Ananthapur, Kurnool, Mahabubnagar Medak and Nalgonda. A number of varieties of pomegranate are cultivated and are distinguished by the shape of the fruit, colour of the rind, thickness of the rind, taste and colour of the sarco-testa. In India, pomegranate was previously grown in kitchen gardens and commercial plantations have come up in recent years, with the introduction of some improved cultivars like Ganesh, Arakta, Sindhur and Jyothi. With the recent developments in dry land, horticulture, the production of this fruit has increased with increased demand in internal trade and export market.

BOTANY OF POMEGRANATE

Table 2

Common name	Pomegranate
Scientific name	<i>Punica granatum</i>
Family	Punicaceae
Chromosome number	2n=2x=16-18
Origin	Iran and Northern Himalayas

The genus has two species, *Punica protopunica* is a wild type and *Punica granatum* is a cultivated type. It has two sub-species, i.e. chlorocarpa and porphyrocarpa. Punica, is the sole genus in the family Punicaceae (ITIS, 2006).

Origin and Distribution

The pomegranate is one of the oldest known edible fruits, grown under varied agro-climatic conditions such as tropical, subtropical and temperate conditions. Pomegranate originated in Iran and its surrounding areas. In the first century, it was introduced in India from Persia. It is one of the first five domesticated edible fruit crops along with fig, date palm, grape and olive. The wild pomegranate rind was thick and high acidic in nature when compared to cultivated pomegranate cultivars (Bist et al., 1994). In Central Asia, the primary difference noted, is the high acidity in wild material. Pomegranate is evergreen in the tropical and deciduous in the subtropical and temperate zones. The fruit is commercially cultivated in countries like Morocco, Pakistan (Baluchistan), Iraq, Iran, China, Japan, Russia and India. In India, it attained the commercial status, only after 1985-86 and now, it is being cultivated on scientific lines, particularly in the states of Maharashtra, Karnataka, Gujarat, Andra Pradesh, Tamil Nadu and Rajasthan.

PROPAGATION METHODS

Many propagated plantations in India have been raised from seedlings, but the trees from seedlings show wide variation in characters. Low yields and poor quality of fruits are mainly due to seed propagation. The common method of vegetative propagation is by rooting of hardwood cuttings. Pomegranate is considered to be difficult to root from stem cuttings because of lack of root promoting cofactors i.e. low sugar content, phenolic compounds and C/N ratio. Pre- conditioning of its shoots, during June-July by girdling and etiolation increases the level of root, promoting cofactors considerably. In hardwood cuttings by treating with the IAA root formation was markedly increased. In Air layering 10000

ppm IBA was used and lanolin as a carrier for improving the rooting. There is a growing demand of pomegranate planting in the world, including India so multiplication of pomegranate through Tissue culture is required for fulfilling the demands. Jaidka and Mehra (1986) demonstrated a high frequency of direct regeneration of roots, shoots and whole plants, without callus formation with cotyledon, leaf and stem explants. Even the possibility of another culture in pomegranate was explored by Moriguchi *et al* 1987, regenerated plantlets successfully from somatic embryos, from cotyledonary tissues of pomegranate multiple somatic embryogenesis. Finally Naik *et al.* (1991) described an efficient procedure for in vitro clonal propagation of Ganesh, using nodal stem segments of a mature tree and then a complete protocol was developed for in vitro regeneration Naik *et al.* (2000).

Spacing and Planting Season

General recommended spacing for pomegranate is 3.5×3.5 and 5.5× 5.5 and June to January is the best planting season and kept open for atleast a month, for sun exposure, drench pits with 0.1% Carbendazim in 5 l/pit and filled with 20 kg FYM, 0.5 kg SSP and 100 g of 2% Lindane powder, along with loose top soil. Under arid conditions, the information on this aspect is lacking. Therefore, a systematic trail was laid out at this institute, in pomegranate cv. Jalore seedless; and the four planting distances, i.e., 5x2, 5x3, 5x4 and 5x5m in order to find out the optimum plant density for obtaining maximum yield of good quality fruits. The optimum spacing for arid condition, therefore observed to be 5x4 or 5x5m depending on soil condition and irrigation system. The observations were recorded on growth parameters, yield and quality characters of the fruits. The plant height varied significantly (from 2.12 to 2.65m) in different spacing. Similarly, the plant canopy (EW and SW) was recorded more in widely spaced plants (5x5m) as compared to closely spaced plants (5x2m). The juice content in fruit on weight basis was 48.0 per cent in 5x2m spaced plants while it was 51.60 per cent in 5x5m spacing. The average weight of the fruit was more (297.70gm) in wild spaced plants as compared to close planting (237.60gm). A yield of 24.60kg per plant was obtained in 5x5m spacing and it was only 15.40kg per plant in 5x2m spacing. The percent cracking was reduced significantly from 32.20 to 25.30 per cent as the plant space is increased. The spacing of 5x5m observed to be optimum under drip condition (Prasad, R.N.2009).

CANOPY MANAGEMENT

Training and Pruning

One or too many stems were not advantageous and uneconomical. The plant should be allowed to retain 4 main stems from the ground level. Prune ground suckers, water shoots, criss-cross, dead, dry and infected branches and twigs regularly. The main stem should be topped at a height of about 70 cm to induce branching. The tree is given a balanced shape during the initial 2–3 years by proper selection of secondary and tertiary branches. Downward growing branches and crossing branches should be removed. While pruning, care should be taken to disinfect the Secateurs with Dettol (1%) or sodium hypochlorite (1%), so that the infection may not spread from one plant to the other.

After the tree is trained, much pruning is not required as the fruits are borne on one year old branches. However, water sprouts and the dry branches should be removed. After about 10 years, old main stems should be renewed by cutting back to make it more productive. In order to keep the interior of the tree open during the growing season, summer pruning is carried out according to the needs.

Pomegranates require pruning each year, and unneeded growth and suckers should be removed regularly. Short fruiting spurs appear primarily on two- or three-year-old wood, and are found growing mostly on the outer perimeter

of the canopy. Light annual pruning encourages growth of new fruit spurs, while more aggressive pruning will significantly impact yield. Therefore, pruning must be performed on an annual or semi-annual basis in order to minimize the onerous task of aggressive pruning, and to reduce the likelihood of removing excessive amounts of fruit-bearing (older) wood. Major pruning should take place during the winter months prior to bud break, with minor pruning for sucker removal in midsummer. Major pruning is where the tree architecture is established. Efforts should be made to maintain an open, vase-shaped tree with enough lateral branches to support the tree (including the weight of the fruit) without excessively inhibiting airflow, sunlight penetration or excessive fruit rub on windy days.

The weight of the fruit on a branch can be substantial. Support these branches to ensure that fruit does not come into contact with the orchard floor, remains clear of farm equipment and is away from ground-level critters. Injury from wind, called limb rub or wind scars, are wounds that can have a major impact on quality for fruit intended for the fresh market, and can lead to entry points for pathogens. Trees can be maintained at a height that minimizes ladder work by the harvest crews (approximately 9 feet), though the trees will naturally grow to 10-12 feet. After year five, ground suckers may be controlled with careful use of herbicides. Massacre (2009) reported that the yield and quality of pomegranate fruits will depend upon the management of Bahar treatment, including selection of Bahar, percentage of leaf shedding after the rest period, pruning method and intensity, application of organic and inorganic fertilizers, use of micronutrients, water management, control of disease and pests etc., Pruning of the trees is very important aspect for improvement of fruit quality and to minimize the pests and disease population. Seven pruning levels were tried to study the effect of pruning in pomegranate. By observing the data, it could be seen that maximum plant spread was recorded in treatment without pruning (2.41 sqmts) and was at par with treatment, that is pruning 30 cm with thinning 2.36 sq mt's, pruning 60 cm with thinning 2.22 sq mt's, pruning 30 cms without thinning 2.22 sq mt's and pruning 20 cm with thinning 2.11 sq mt's. The early flowering was noticed in the treatment 20 cm pruning with thinning while it was late in without pruning treatment. The days required for harvesting were at par with each other in all treatments. Average number of fruits registered maximum in 20 cm pruning without thinning and was at par with remaining treatments. The maximum fruit yield was observed in treatment 20 cm pruning with thinning and was at par with all other treatments.

Severe pruning and retaining 30 fruit load per plant in two year old trees resulted in recording highest fruit weight (424.28g) which amounted to over 67 per cent rise as compared to unpruned. This treatment, however reduced the overall yield by the amount of 20 percent. It is possible that, higher fruit weight observed in the pruned tree may fetch a higher price in the market, thus compensating loss in the yield, with regard to the quality of the fruit, the fruit developed on the tree, which were subjected to severe pruning with 30 fruit load per tree were superior, in respect of 100 aril weight, total soluble solids and total sugar content.

Flowering and Fruiting

The flowering period of pomegranates occurs about one month after bud-break, and varies from variety to variety and is governed by agro-climatic conditions (Holland *et al.*, 2009). The flowers may be solitary or grouped and can be classified as male, hermaphroditic, and intermediate. Differences between male and hermaphrodite flowers are apparent in the shape and colour of the calyx, and the number of the hermaphrodite flowers determines fruit set capacity and yield in pomegranates. The ovary of a male flower is rudimentary whereas those of intermediate flowers are of the degenerating type. If fruit set occurs in such flowers, they may drop before reaching maturity, and even if some fruits reach maturity they are often deformed. The time of dehiscence of the anther variable in different cultivars and no general sequence is

found at the time of anthesis (Melgarejo *et al.*, 1997). The percentage of flowers that are male in pomegranate can be significantly high, exceeding 60 to 70 percent, depending on variety and season (Holland *et al.*, 2009; Wetzstein *et al.*, 2011). For example, studies have shown that, the number of male flowers ranged between 43 and 66 percent for Israeli Wonderful and 78 to 86 percent for "Hicaznar", grown in Turkey. The pomegranate flower is self- and cross-pollinated, mainly by bees (Morton, 1987), but cross pollination is reported to have higher rates of fruit set (Derin and Etis, 2001; Mir *et al.*, 2012). Fruit development starts after flowering of the ovary, with flowering and fruit set lasting about one month (Holland *et al.*, 2009).

Local Indian types remain evergreen in nature under sub-tropical conditions where as exotic types show deciduous nature, sparse flowering and produce small sized fruits having blood red aril colour but are highly acidic with seeds. Flowers are borne on current and past seasons 'growth, solitary or clusters in axils of leaves or on terminals. Sex expression is greatly influenced by season. The hermaphrodite flowers give a higher fruit set than the intermediate type of flowers. The fruits developed from solitary and axillary flowers are much bigger, than those produced from terminal flowers. The bearing habit differs vastly with different cultivars. Ganesh and Bassein Seedless produced about 70 percent of their flowering, on the main axis and remaining 30 percent on the first order branches, whereas the proportions were almost equal in Orlando. The direct flowering from first order branches was about 30 percent in Ganesh and Bassein Seedless and 50 percent in Alandi. The rest of the flowering i.e 30-40 percent is on current growth. For effective bearing in pomegranate, it is desirable to have vigorous shoots with sylleptic branches, which may give about 30 percent flowering, for the current season and contribute to 70 percent of flowering in the ensuing season, either by direct flowering or main axis or on the first order branches.

FLOWER REGULATION

Pomegranate can be grown throughout the year, but a rest period of 3–4 months was necessary to prolific harvest and one crop should be taken in a year for best quality fruits. There are 3 main Bahar treatments, each have its own advantages and disadvantages.

Table 3

Bahar Treatment	Flower Initiation Months	Harvesting	Advantages
Ambe Bahar	January–February	June–August	High flowering, yield but fruits are more prone to sunscald and aril color development is poor. Summer showers may favor the spread of bacterial blight
Mrig Bahar	June–July	November–January	Assured rainfall, but more prone to bacterial blight
Hasta Bahar	September–October	February–April	Less incidence and spread of bacterial blight and it may be preferred

(NRC on pomegranate, 2011)

Thinning of Fruits

When all factors are favourable, trees can set too much fruit on trees and may have a negative effect on the following season's yield and will also impact on the current season's fruit size (small-sized fruit of poor quality). To avoid this, thinning of fruits, 4 – 5 weeks after flowering could be useful. A general rule will also be to thin out the fruits borne on weak spurs, deformed and damaged fruits. Generally the early flowers will result in the larger fruit, and a warmer spring

will enhance larger fruit sized for that season. Thinning fruits can be applied at the end of last week of May – 1st week of July by leaving 1-2 fruits/cluster. Avoid putting young trees under conditions of stress. Mature trees tend to hold more fruit that are set than will younger trees. Thinning also tends to reduce fruit drop because the tree (or bush) is better able to produce enough nutrients to maintain a 'thinned' crop load than an excessive crop load.

Flowers and fruit thinning are considered unpredictable with plant growth regulators and chemicals as the tree continues their growth and flowering if irrigation is not withheld. However, Shay any and Sharif (1973), reported that, ether 2000ppm did cause fruit and leaf abscission. Likewise, also 500-3000ppm do induce flowering and fruit drop in different cultivars (Tafazali and Badizadegan (1972).

QUALITY IMPROVEMENT

Larger and sweet fruit with low incidence/insects were obtained from Ambe-Bahar, in Southern and Central India, but have poor aril colour and suffer badly from fruit cracking (Phadnis, 1974). In Maharashtra, aril colour developed and sweetness increases as the ripening advances from June to August. In Northern India, fruit quality, with respect to aril colour and sweetness is better in fruits of Mrig Bahar than Ambe-Bahar, this indicates that, intensity of grain, rind colour and aril sweetness is much dependent on temperature prevailed, during the fruit development period . Fruit cracking is much dependant on fruit pliability, fluctuations in relative humidity and soil moisture status near fruit maturity and ripening. Sen and Chauhan (1983), reported on the improvement in juice and sweetness with the use of NAA.

Use of Growth Regulators

Investigations were undertaken to study the effect of growth regulators, on fruit development and quality of pomegranate cv. Ganesh during 1994, among the growth regulators, 2,4-D 20 ppm recorded the highest fruit length and girth, followed by 2,4- D 10 ppm. 2, 4-D 20ppm registered the highest fruit weight and volume, to an extent of 375.41 and 405.14 percent increase over control. GA3 at higher concentration generally affected the fruit length, girth and volume as compared to control. Ethrel (30ppm) recorded the lower thickness and rind percent, whereas GA3 and NAA (100 ppm) caused marked increase in rind thickness, Aril weight, aril percent and aril rind. Aril percent, markedly increased by 2,4-D 20ppm. All the treatments recorded low rag percent as compared to control GA3 treated fruit recorded the lowest rag content and CCC treated recorded the highest.

Irrespective of the growth regulators treatments including fruit length, girth, weight, volume, aril percent, and aril: rind ratio and juice content showed an increasing trend of different stages of fruit development, while rind thickness and rind percent and rag percent, showed a decreasing trend with variation in magnitude, as influenced by different growth regulators. 2, 4-D 20 ppm recorded the highest TSS, total and reducing sugars, TSS:acid ratio and Ascorbic acid content. The lowest acidity was recorded in ethrel 50ppm,, as compared to high acidity in fruits treated with NAA 25ppm and GA3 and CCC influenced the yield, in terms of no of fruits per tree followed by 2,4D 20ppm, when yield in terms of weight per tree was considered.

Irrigation and Nutrient Management

Pomegranate is generally thought to be drought resistant crop because once established it can survive in semi-arid regions with no additional irrigation. But it is sensitive to even slight water deficit that affects stem, root and leaf growth adversely (Badizadegan 1975). However, from a commercial point of view, it should not be considered as a drought

tolerant plant and irrigation should be scheduled so as not to stress the plant. The most sensitive phase of plant growth cycle occurs during pollination and fertilization. Water deficits will result in the splitting of the fruit (Still 2006). Therefore, irrigation management is highly essential in pomegranate for higher yield and quality fruit production. Water requirement varies in different seasons and growth stages. At present, drip irrigation is common in pomegranate growing countries which can save up to 66 per cent of the water compared to surface irrigation (Chopade *et al*, 2001).

The pomegranate can withstand long periods of drought. In mature orchards, the amount of irrigation depends on the climate and soil. Generally, a month before harvest time (ripening stage) irrigation should be stopped to avoid fruit cracking, after harvest very little irrigation is carried out, then, monthly irrigation till (Nov. – Feb.). Winter irrigation is avoided. Any further winter irrigation will only spur long, vegetative, non fruiting spring growth. The 1st irrigation will be applied after the 1st dose of chemical fertilizers. Irrigation should be regulated during the critical periods (blooming, fruit set and maturity). Less water will result in poor fruit size, higher fruit drop, stressed trees and may return bloom. Heavy irrigation may result in dropping flowers and increasing fruit cracking. The amount of irrigation should be increased during summer time (maturity stage).

Table 4: Water Requirement Monthly Wise in Pomegranate

Cropping Season	Month	Water Requirement (Lit/Day/Plant)
Ambe	Jan	17
	Feb	18
	Mar	31
	Apr	40
	May	44
Mrig	Jun	30
	Jul	22
	Aug	20
	Sep	20
	Oct	19
	Nov	17
	Dec	16

(NRC on pomegranate, 2011)

Mulching

Mulching plays very important role in respect of moisture conservation, reduction of weeds and nematode control especially in pomegranate. Deficiency of moisture in the soil during the fruit development stage is responsible for fruit cracking and reduces the fruit quality in pomegranate. Besides, controlling the weed population, mulching with black polythene paper reduce population of nematodes which is one of the serious causes of wilting in pomegranate.

By considering this aspect, an experiment was laid out during 2008- 2009 at Dept of Horticulture MPKV, Rahuri. Four different types of mulches were used in the pomegranate orchard. The treatment differences were significant in various characters. Among the treatments, mulching with black polyethylene sheet was found superior in respect of growth of plant yield of fruits. Significantly highest marketable and total yield (15.55 and 17.09 kg per tree, respectively) was recorded by the treatment of mulching with black polyethylene paper and was at par with treatment of mulching with sugar cane trash, soybean straw and weed straw. The average number of fruits (58.75) and the average weight of fruits (268.75g) were also found maximum in the treatment of black polyethylene mulch. (Warade. 2009)

Pomegranate cultivated on marginal and poor soils requires replenishment of nutrients removed from the plant.

Table 5: The Common Fertilizers Dose in Kg per Plant/Year is as Follows

Plant Age (Years)	FYM (Kg)	CAN (Kg)	SSP (Kg)	MOP (Kg)
1	10	0.5	0.60	0.25
2	15	1.0	0.70	0.50
3	20	1.5	1.00	0.75
4	20	2.0	1.50	1.00
>5	20	2.5	1.50	1.00

A full dose of FYM, Single Super Phosphate, and half dose of Muriate of Potash and Calcium Ammonium Nitrate has to be applied during winter (December-January) and the remaining dose of CAN and MOP may be applied in two splits – once at the time of fruit set and the remaining a month after that in a band about 15 cm away from the tree. Micronutrients are also essential for pomegranates about 50 g each of micronutrients in the form of ZnSO₄, FeSO₄, MnSO₄ and CuSO₄ are recommended to be added each year to avoid any deficiency.

Harvesting and Yield

Pomegranate fruit attains maturity in about 120-160 days from fruit set depending upon the variety. A maturity fruit gives a characteristic metallic sound when pressed gently and attains colour, specific to the variety. The Yield level varies from 8-15 t ha⁻¹. Fruits can be graded, depending upon the size (weight) into different categories.

Table 6: Grading and Packing

Fruit Grade	Fruit Weight	Skin Colour	Skin Quality
Super sized	> 750g	Good attractive bright red colour	No spots on skin
King sized	500-700g	Attractive red colour	Spot free
Queen sized	400-500g	Bright red	Spot free
Prince sized	300-400g	Fully ripe bright red	Spot free
12 A	250-300g	Fully ripe red colour	Spot free
12 B	250-300g	Fully ripe red colour	Some spots

Importance and Uses

Pomegranate consumed as a fruit or juice. Pomegranate was traditionally used for contraception, snakebite, diabetes and leprosy, tannins used to halt diarrhea and hemorrhage, whereas dried flower buds flour was a remedy for bronchitis.

Due to its immense potential for health benefits and nutritional benefits, pomegranate has achieved the title of “super-food”. Despite its usefulness, pomegranate remained mostly a neglected and underutilized plant. However, there is now a rapidly increasing body of knowledge about the usefulness of pomegranates for mankind, such as its importance to treat obesity and heart problems and cancer.

PROCESSED PRODUCTS

Pomegranate fruits can be processed into different fermented and non fermented beverages. Besides that, other processed products like jam, anardana can also prepare for it. The different processed products prepared from pomegranate are as follows:

Pomegranate Juice: The juice of pomegranate is highly nutritious and is recommended, particularly patients

suffering from the gastric troubles. It has a TSS of 16-18 degree Brix and acidity of 0.35 – 0.40 percent. The juice recovery from fruit is 42 percent on whole fruit basis, while it is about 72 percent, on the basis of aril weight. The juice is extracted from the arils by basket press and then it is clarified, by setting for 24 hours and filtering. After that, the juice is pasteurised at 85 c / 30 min, sodium benzoate (600 ppm) is added and finally bottled and crown corked while the juice is still hot.

Pomegranate Vine: Juice is extracted from the pomegranate arils and to it the sugar is added to make it 22 – 23 bricks. Potassium metabisulphate is added to the juice to prevent the growth of undesirable micro organisms. Then, juice is inoculated with vine yeast starter cultures (2 per cent v/v) and allowed for fermentation and aging. Finally, the vine is flash pasteurized, bottled hot and sealed.

Pomegranate Jam: For the preparation of jam the arils are separated from the fruit and the juice is extracted from the arils. Then the juice is heated and citric acid, sugar and pectin are added. It is then boiled up to 67 degrees Brix and finally, filled hot in sterilized bottles, waxed, capped and stored.

Anrdana: It is prepared by drying the seeds of pomegranate. This is a value added byproduct, used as an acidulant and condiment, in curries and also in Ayurvedic and Unani medicines. The dried product contains more acid, sugar and crude fiber, compared to fresh fruit.

Canned Arils: The arils of pomegranate fruit are put into metal cans, with sugar syrup of 15 degree brix. Then, they are heated, sealed and sterilized for 10 min. Finally, they are stored in cool and dry place.

Minimally Processed Pomegranate Arils

Pomegranate consumption is limited due to difficulty in peeling to obtain the arils. Therefore, pomegranate arils are processed into "ready –to –eat" convenient form. The arils are separated from the pomegranate fruit and washed with chlorine and citric acid solution. After rinsing, they are air- dried, packed in polythene bags and stored in cold storage.

Nutraceutical Compounds

Over the past decade, rigorous efforts have been made by researchers to investigate the nutraceutical compounds in pomegranate and their effects on human health. As a result, many compounds like phenols, alkaloids, organic acids, etc. have been identified and characterized. Phenolics, tannins are the most abundant one and mainly present in the form of hydrolyzable tannins. Among hydrolyzable tannins, ellagitannins and galotannins are the major compounds, present in the different parts of the pomegranate. Another important phenolic group is flavanoids. Besides, many phenolic acids and their derivatives have been identified in pomegranate. Among different phenolic acids, caffeic acid, fumalic acid, chlorogenic acid and p-coumaric acid are present in the aril and pericarp. Punicalin and punicalagin, derevatives of ellagic acid are unique to this crop.

Alkaloids are mainly found in the bark of both stem and root. It is also present in the fruit. Mainly two kinds of alkaloids are present the plant, namely, preparedness and pyrrolidines. The arils are rich in organic acids like citric acid and malic acid. In addition, tartaric acid, oxalic acid and succinic acid are also found. The main sugars present the arils are glucose, fructose and sucrose. The seeds are rich in unsaturated fatty acids, including punicic acid, linolic acid, oleic acid, palmitic acid, steric acid and linolenic acid. Apart from it, the seeds also contain steroids such as sterols and sex steroids .Beside; arils are also rich in vitamin – C which provides of about 17 per cent of a daily vitamin-c requirement per 100 ml serving.

MEDICINAL PROPERTIES

Cardio-Protective

Recently, due to changing dietary pattern, people are becoming prone to several cardiovascular diseases like hypertension, coronary heart disease, atherosclerosis, stroke etc. Several epidemiological studies suggested that regular consumption of foods and beverages rich in phenolics, especially flavonoids reduces the risk of cardiovascular diseases. In this context, pomegranate has received much attention among the researchers, due to its specific phenolic composition. Reduction of cardiovascular diseases is attributed to its strong antioxidant activity.

Castro protective: The leaves and pericarp of pomegranates were reported to possess gastro protective activity. This activity is due to the presence of astringent tannin in the leaves and pericarp extract. This compound binds with the protein and inhibits the bacterial activity, thus reduces the incidence of gastric ulcer.

Anti diarrhoea and Anti helmenthic: The pericarp of pomegranate fruit has been used in china, to dispel intestine parasite since ancient time. The mechanism involved is believed that, it creates continuous contraction of the intestinal tract. The extract of leaf, bark and root also posses antidiarrheal activity. It derives due to astringent property resulted predominantly from tannins, which have antibacterial effect against *escherichiacoli*, *Shigella sonnei*, *Shigella flexneri* and *salmonella typhi*.

Antibacterial and anti viral: Apart from the bacteria mentioned above, the extract of pomegranate pericarp, also inhibit the growth of some common pathogenic bacteria, especially gram positive pathogens. It is reported that, microbacteria tuberculosis, vibrio cholera, staphylococcus aureus, staphylococcus hemolyticus, yersinia entero colitica, listera mono cytogenes etc. are highly susceptible to the extracts of pomegranate. The major compound responsible for this antibacterial activity was found to be tannins especially ellagitannins and flavanoids. These compounds also have antiviral property. The tannin present in aqueous extract of pericarp and arils effect the enzymes involved in the life cycle of virus by precipitation of proteins, thus posses anti viral prosperity. Another compound punicalagin, reported to inhibit the influenza virus by blocking the replication viral RNA. In the eastern part of orrisa (INDIA), due to prevalence of endemic parasite *Plasmodium vivax* and *P. falciparam* malaria and phylaria are major health problems. Sun-dried rind of the immature pomegranate fruits is presently used there, as an herbal formulation with the name of OMARIA, for the therapy and prophylaxis of malaria.

Anti diabetic: Pomegranate flowers have been used in both the Unani and ayurvedic systems of medicine, as a remedy for diabetes and as a supplement in the diet therapy. The extract of the flowers is highly effective in lowering the blood glucose level of type2 diabetes. Gallic acid present in flowers is mainly responsible for this activity. It has been reported that, the extract of flowers improve the sensitivity of insulin receptor and peripheral utilisation of glucose there by inhibit hyper glycaemia.

Anti cancer: Pomegranate fruit, seed and seed oil can interfere with the occurrence and development of cancer (prostate, breast, skin, colon, lung, oral and leukaemia) pro anti oxidant, anti proliferation (growth inhibition, cell cycle disruption and opoptosis), anti anginogenesis and anti inflammatory mechanisms. It is found that, phenolics and fatty acids are the major anti inflammatory constituents and present in large proportion in seeds. Among fatty acids, punicic acid and ellagic acid inhibit the development of inflammation through suppressing bio synthesis of prostaglandin. Thus, the extracts of pericarp selectively inhibit the cancer cells and minimally affect the normal cell, which suggests their potential

therapeutic use in cancer treatment.

Effects of the pomegranate against diarrhoea: Only two studies have been conducted recently that demonstrated the effect of pomegranate peel extract in the prevention of diarrhoea. Both experiments were conducted on laboratory rats; after the administration of a pomegranate peel extract, it was observed that both the number of bowel movements and the mass of the same were reduced. The studies were conducted by the dose proposed by the latter for the treatment of this condition was 400 mg per kg of body weight.

Effects of the Pomegranate on Sperm Quality and Erectile Dysfunction

The basic purpose of semen is reproduction, since it acts as a “vehicle” for transporting sperm to the female reproductive tract. Although orgasm and sexual pleasure accompany the ejaculation of semen, erection and orgasm are controlled by independent mechanisms, thus the emission of semen is not essential for the enjoyment of sex. Consumption of pomegranate juice produced an increase in the concentration of sperm in the epididymis, an increase in mobility and a greater density of spermatogenic cells; it also reduced the amount of poor quality semen, compared to the reference or control group. In a more recent study, this same research group suggested that, ellagic acid has a protective effect on testicles and sperm. This effect may be related to the potent action of ellagic acid, against oxidative stress.

Erectile dysfunction is the repeated inability to develop or maintain an erection which is firm enough for successful sexual intercourse. It was found that after four weeks of consumption of pomegranate juice, patients showed better erectile function than other patients who had been given a placebo.

Effects of the Pomegranate on Obesity

Obesity is a chronic disease of multifactorial origin, that is characterised by the excessive accumulation of fat or general hypertrophy of adipose tissue in the body. Obesity, therefore, refers to a situation, where the natural energy reserve of humans and other mammals, stored as body fat, increases to a point, where it is associated with multiple complications, such as certain health conditions or diseases and increased mortality. The World Health Organisation’s (WHO) definition of obesity is when the Body Mass Index (BMI), which is a calculation based on an individual’s height and weight, is equal to or greater than 30 kg/m². Another sign of obesity is an abdominal perimeter greater than or equal to 102 cm in men and 88 cm in women.

Obesity forms part of the metabolic syndrome, and is a known risk factor. In other words, it increases the risk of developing various diseases, particularly cardiovascular disease, type 2 diabetes mellitus, sleep apnoea, stroke, osteoarthritis, and some forms of cancer and dermatological and gastrointestinal ailments. Although obesity is an individual clinical condition, it has become an increasingly serious public health problem, and the WHO believes that “obesity has reached epidemic proportions worldwide, and at least 2.6 million people die each year because of obesity or overweight. Although previously considered a problem confined to high income countries, obesity is now also prevalent in low and middle income countries”.

Table 7: Commercial Varieties

Variety	Characteristics
Ganesh	This variety has pinkish yellow to reddish yellow rind colour, having light pink arils and soft seeds. Fruit weighs between 225-250 gms with medium T.S.S.
Mridula	Fruit has bright red skin colour and weighs between 230-270 gms. The seeds are soft and high T.S.S.

Table 7: Contd.,	
Ruby	The fruit skin is red in colour and weighs between 225-275 gms. The grains are soft, having high T.S.S.
Arakta	Fruits are dark red in colour with soft seeds and with high T.S.S.
Bhagwa	The fruit is glossy red in colour with soft seeds and high T.S.S.

RESEARCH FINDINGS:

Irrigation and Fertigation of Pomegranate Cv. Ganesh in Chhattisgarh. Prabhakar Singh, A.K Singh and Kamlesh Sahu (2009)

Field trials of pomegranate cv. Ganesh were conducted HRF, IGAU, Raipur.

Treatment Combinations

T₁ (Control) = Surface irrigation + Recommended dose (RD) of NPK (625, 250 and 250 g/plant respectively),

T₂ = Drip irrigation + RD

T₃ = 50% of RD through fertigation,

T₄ = 75% of RD through fertigation

T₅ = 100% of RD through fertigation

T₆ = 125% of RD through fertigation

The seasonal water requirement for 20 per cent wetted area was less in drip-fertigation, than in surface fertigation. The former method saved about 27.5 percent water, over the latter method. The fertigation at 75 percent level (i.e. application of recommended dose of water-soluble fertilizer, through water had at par water use efficiency, compared to the fertigation at 100 percent level. The fertigation, at 75 percent level was found to give yield at par with that giving highest yield and the fertigation at 75 percent level was also found to be most economical and profitable, fetching the highest net profit and the highest benefit cost ratio.

Table 8: Yield and Yield Attributing Characters as Influenced by Irrigation and Fertigation Combined Effect

Treatment	Total Yield/Plant	No of Fruits/Plant	Avg Marketable Yield/Plant	Avg Fruit Wt/Plant
T1	9.89	46.00	7.77	194.59
T2	10.18	48.22	8.15	212.30
T3	10.05	47.88	8.19	210.54
T4	14.50	67.22	12.23	223.72
T5	14.89	67.11	12.27	224.06
T6	13.98	63.44	11.38	218.25
CD at 5%	1.26	5.13	1.25	5.84

Table 9: Qualitative Characters as Influenced by Combined Effect of Irrigation and Fertigation

Treatment	Juice (On Aril Weight basis) (%)	TSS (%)	Acidity (%)	Reducing Sugars (%)
T1	80.76	14.86	0.40	10.01
T2	80.65	15.19	0.35	10.82
T3	80.21	15.21	0.33	10.22
T4	81.88	15.74	0.34	11.27
T5	81.10	15.90	0.38	11.30
T6	81.21	16.30	0.36	11.36
CD at 5%	0.86	0.93	0.03	NS

(Singh *et al.* 2006)

Table 10: Water Use Efficiency and Economics of Treatments Involving Surface Irrigation, Drip Irrigation System and the Drip Irrigation with Fertigation Process

Treatment	Cost of Cultivation (Rs./Ha)	Gross Income (Rs./Ha)	Net Income (Rs./Ha)	Benefit: Cost Ratio
T1	52197	97063	44866	1.86
T2	52654	101913	49259	1.93
T3	65054	102375	37321	1.57
T4	75149	152825	77676	2.03
T5	85246	153375	68129	1.80
T6	95343	142250	46907	1.49

Growth and Yield Performance of Pomegranate Varieties under Scarce Rainfall Zone**(K. Dhanumjaya Rao and K. Subramanyam 2010)**

Eight varieties of pomegranate were evaluated under scarce rainfall zone, at Horticultural Research Station, Anantapur for 3 years from 2004-2006 in 9 years' old plants. Out of 8 varieties, the average plant height (2.64 m) and No. of branches/plant (3.7) were recorded highest in Jodhpur red, followed by Jalor seedless. Highest stem girth was recorded (34.3 cm) in Ganesh followed by P 23 (32.8 cm). Plant spread was highest in Jalor seedless (6.4 m³), followed by Muscat (5.1 m³). The fruit yield i.e. No. of fruits/plant was recorded highest (61.6) in Ganesh followed by G 137 (59). Ganesh with highest yield i.e. No. of fruits/plant (61.6) and G 137 (59) were best suitable to scarce rainfall areas in poor fertile soils.

Table 11: Growth and Yield Performance of Pomegranate Varieties under Scarce Rainfall Zone

Varieties	Plant Height (M)				No. of Branches			
	2004	2005	2006	Mean	2004	2005	2006	Mean
Ganesh	2.15	2.60	2.16	2.30	3.60	3.80	4.60	4.00
G -137	2.10	2.63	2.06	2.30	3.30	3.50	4.20	3.70
Muscat	2.50	2.40	2.12	2.30	2.70	2.80	4.80	3.40
Jodhpur Red	2.70	2.90	2.32	2.60	2.60	2.90	5.60	3.80
Jalore Seedless	2.50	2.80	2.30	2.50	3.20	3.40	4.40	3.70
P-23	2.25	2.70	2.00	2.30	2.30	2.50	3.40	2.70
GKVK-1	1.75	2.15	1.60	1.80	2.40	2.50	1.00	2.00
Ruby	2.30	2.00	2.20	2.20	4.00	3.20	3.00	3.40

Table 12

Varieties	Plant Spread (M ³)				Fruit Yield (No. of Fruits/Tree)			
	2004	2005	2006	Mean	2004	2005	2006	Mean
Ganesh	4.60	4.70	2.66	4.00	98.60	52.00	35.00	61.60
G -137	4.50	3.88	2.31	3.60	40.00	77.00	60.00	59.00
Muscat	7.30	4.97	3.05	5.10	29.50	64.00	40.00	44.60
Jodhpur Red	3.29	4.72	3.62	3.90	30.00	63.00	45.00	46.00
Jalore Seedless	8.15	8.02	3.16	6.40	39.00	54.00	55.00	49.30
P-23	5.12	6.36	2.26	4.60	42.00	58.00	40.00	46.60
GKVK-1	3.90	2.36	1.50	2.60	40.90	19.00	25.00	28.00
Ruby	3.90	4.62	2.50	3.60	23.00	26.00	27.00	55.30

(K. Dhanumjaya Rao and K. Subramanyam 2010)

Effect of Nitrogen Fertigation on Growth and Yield of Pomegranate Var. Mridula under Low Rainfall Zone. HRS-ATP. K. Dhanumjaya Rao and K. Subramanyam 2010

Highest plant height (2.0m), number of fruits (45.1) and fruit yield (11.6 kg) per tree were recorded in T₇

treatment (50 per cent recommended dose of nitrogen at fortnight intervals) plant height (1.9 m) and number of fruits (42.0) and fruit yield (9.4 kg) were recorded. Plant spread was recorded highest (2.4 m³) in T₆ treatment followed by T₇ treatment (2.2 m³) when nitrogen fertilizers were applied through drip irrigation. 50 per cent of nitrogen at fortnight intervals enhanced yield in pomegranate per tree under low rainfall zone. It also saved 50 per cent nitrogen fertilizers cost and labour cost.

Treatment Combinations

T₁– Soil application of nitrogen 50% at first irrigation (after pruning) + 50% after 3 months

T₂– 100% recommended dose of nitrogen at monthly intervals (6 times)

T₃–100% recommended dose of nitrogen at fortnight intervals (12 times)

T₄–75% recommended dose of nitrogen at monthly intervals (6 times)

T₅–75% recommended dose of nitrogen at fortnight intervals (12 times)

T₆–50% recommended dose of nitrogen at monthly intervals (6 times) and

T₇– 50% recommended dose of nitrogen at fortnight intervals (12 times)

Table 13: Effect of Nitrogen Fertigation on Growth and Yield of Pomegranate Var Mridula under Low Rainfall Zone

Trs	Plant Height (Meters)				Stem Girth (Cm)				Plant Spread (M ³)			
	2004	2005	2006	Mean	2004	2005	2006	Mean	2004	2005	2006	Mean
T1	1.58	1.72	1.71	1.70	1.9	51.9	50.1	34.7	1.40	1.58	2.18	1.70
T2	1.68	1.62	1.52	1.60	25.6	35.7	54.8	38.8	1.04	0.93	2.50	1.50
T3	1.91	1.93	1.73	1.85	21.2	49.1	49.2	39.9	1.65	1.44	2.47	1.90
T4	1.90	1.71	1.65	1.80	21.6	46.6	57.3	41.9	1.29	1.28	2.36	1.60
T5	1.69	1.82	1.58	1.70	18.9	43.3	57.3	39.9	1.48	1.40	1.97	1.60
T6	1.97	2.00	1.83	1.90	26.3	48.3	53.1	42.6	2.18	1.66	3.34	2.40
T7	1.84	2.15	1.89	2.00	21.8	51.8	56.8	43.5	2.28	12.9	2.31	2.20
SE. m±	0.12	0.13	0.14		1.66	4.52	3.35		0.35	0.28	0.30	0.30
CD at 5%	0.16	0.18	0.17		0.21	0.45	0.52		0.16	0.14	0.91	0.90

Table 14: Effect of Nitrogen Fertigation on Growth and Yield of Pomegranate Var Mridula under Low Rainfall Zone

Treatments	No. of Fruits/Tree				Fruit Yield/Tree (Kg)			
	2004	2005	2006	Mean	2004	2005	2006	Mean
T1	12.70	47	46	31.90	7.10	8.10	6.80	7.40
T2	16.20	45.00	31.00	30.70	6.90	7.00	5.70	6.60
T3	24.50	49.00	40.00	37.90	7.70	8.70	8.30	8.30
T4	18.10	28	17	21	4.30	5.80	4.30	4.90
T5	16.10	54.00	43.00	37.70	8.00	8.60	7.50	8.10
T6	31.10	54.00	41.00	42.00	9.60	9.70	8.70	9.40
T7	21.40	65.00	49.00	45.10	12.80	13.80	8.20	11.60
SE. m±	0.034	0.02	0.03		0.04	0.01	0.02	
CD at 5%	0.27	0.45	0.18		0.30	0.80	0.23	

Dhanumjaya Rao.K. and Subramanyam.K, 2009.

SUCCESS STORIES

Table 15

1. Name of Farmer	Papi Reddy , Beluguppa Mandal, Ananthapuramu Dist.
Total cultivated area	20 acres bearing orchard 22 acres pre-bearing orchard
Total area under pomegranate	42 acres
Total Pomegranate Production	150 tonnes
Income from pomegranate/year	Rs. 75.00 lakhs (Rupees seventy five lakhs only) from 20 acres
Cost of cultivation/acre	Rs. 25,000 to 30,000/- per acre
Innovations/ Technology/package followed	<ul style="list-style-type: none"> ➤ Strictly adopting the phytosanitation ➤ Pruning with disinfected secateurs ➤ Able to produce the healthy fruits even during the epidemic conditions of the disease in the district ➤ New orchard is planted with tissue culture plants ➤ Interested in organic farming and integrated approach for the cultivation of the crop
Awards and Recognitions	Received Best Pomegranate Grower award from the State Government.
2. Name of Farmer	P. Vijayalakshmi , Kondampalli village, Penukonda Mandal, ATP.
Total cultivated area	22 acres bearing orchard 12 acres pre-bearing orchard
Total area under pomegranate	34 acres
Total Pomegranate Production	120 tonnes
Income from pomegranate/year	Rs. 60.00 lakhs (Rupees sixty lakhs only)
Cost of cultivation/acre	Rs. 40,000 to 45,000 per acre
Innovations/ Technology/package followed	Integrated approach for crop cultivation Adopting phytosanitation Pruning with disinfected secateurs
Awards and Recognitions	Received Best Pomegranate Grower award from State Government.
3. Name of Farmer	Shri. Sh Genabhai Lakhani, Gujatath.
Total cultivated area	50 acres
Gross income from 5 ha.	85.80 Lakh
Total Pomegranate Production	300 tonnes in 30 acres
Net profit 2012-13	75.80 lakhs
Achievement	Drip, mulching and bird protecting nylon net
4. Name of Farmer	Shri. Bramhadev Kisan Pune, Maharashtra
Total cultivated area	25 acres 12 acres Ganesh and 13 acres Bhagwa
Cost of cultivation/year	2.5 Lakh
Income/year	1.25 Crore since 4 th bahar
Production	169 tonnes of Bhagwa from 10 acres 40 tonnes Ganesh from 2 acres
Description of technology	Use of organic manure 16 tonnes/acre/2years and 27 tonnes/acre/annum third year onwards.
4. Name of Farmer	Shri. Subhash Borate
Total cultivated area	6.5 acres 2 acres Ganesh and 6.5 acres Bhagwa
Cost of cultivation/year	50000-6000/-
Income/year	3 lakh/annum
Description of technology	Intercropping with wheat and gram, papaya and onion

CONCLUSIONS

- Pomegranate – Best suitable crop for arid regions.
- Crop can be managed with limited water resources.
- Bhagwa, Mridula and Ganesh are the popular varieties.
- Hasta Bahar crop is recommended in A.P to escape from bacterial blight.
- Bhagwa variety has high export potential.
- Pomegranate fetches high net returns (Rs 5 to 6 Lakhs /ha) as is evidenced from success stories.
- Juice, jam, jelly, RTS, molasses, seed oil, wine, juice powder, cosmetics, pomegranate arils, seed and rind waste are the value added products that can be prepared from pomegranate.
- There is a great demand for processed pomegranate arils in India and other countries.

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